Colorado Early Childhood Workforce Data Brief #1

Longitudinal Analysis of Early Childhood Workforce Datasets, 2019–2023

REPORT HIGHLIGHTS:

- Data from the **Professional Development Information System (PDIS) may be used longitudinally to explore retention** within this workforce.
- This brief recommends **process updates to improve the quality of the data** for measuring the workforce over time.
- Proposed workforce **metrics include workforce growth and retention** (for all workers and specific roles), as well as retention of new workers.

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Report Number: 23-02A. Date: April 2024

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Acknowledgements

This work would not be possible without anonymized data provided by the Linked Information Network of Colorado (LINC). The findings do not necessarily reflect the opinions of the Colorado Governor's Office of Information Technology or the organizations contributing data.

Introduction

The State of Colorado has prioritized early childhood education and the growth and stability of its early childhood workforce.[1] In 2022, the Colorado Department of Early Childhood (CDEC) was launched and, citing low pay and high turnover in the field, the legislature passed a bill to provide some childhood educators with a tax break.[2] At the same time, Colorado has invested resources and implemented policies to improve data collection with the goal of better understanding early childhood workforce trends over time. Between 2020 and 2021, Colorado made two significant changes to improve the collection and analysis of workforce data: 1) migrating the Professional Development Information System (PDIS) to a new platform with system improvements, and 2) instituting a policy requiring providers to verify their current staffing in PDIS in advance of licensing inspections.

The Colorado Evaluation & Action Lab (Colorado Lab) partnered with Chapin Hall to analyze the improved early childhood workforce data with the goal of better understanding the preparation, advancement, and retention experiences of these workers to inform policies and investments designed to support them. The Linked Information Network of Colorado (LINC) was used to bring together datasets from multiple state agencies in Colorado to inform our understanding of the early childhood workforce.

Key Findings & Recommendations

- **Finding:** Significant differences in the way active employment status was defined before and after the PDIS system redesign do not allow for accurate tracking of worker history and retention over time.
- **Recommendation:** Define the early childhood workforce based on verified employer but conduct some analyses for role-specific subpopulations.
- **Finding:** Because the data verification process happens at different times during the year for different providers, longitudinal measures of worker employment are difficult.
- **Recommendation:** Create a common timeline for entering and verifying employment information for staff across all licensed providers.
- **Recommendation:** Define consistent workforce metrics (including retention and growth) so they can be used for ongoing monitoring.

Purpose of This Brief

This brief discusses employment status measures captured in PDIS and explores methods for measuring the retention or employment history of early care and education (ECE) workers over time. Key questions addressed in the brief include:

1. To what extent can we track ECE workers' employment trajectories across data from before and after the PDIS redesign and new employment verification policy?

2. How can retention of ECE workers across years be measured using the latest PDIS data? How can the ECE employment history of workers in a given year be measured?
3. What measurement challenges exist in understanding longitudinal employment trends? How might these challenges be addressed?

Methods

The PDIS data for these analyses were prepared by the LINC team. PDIS data contain workforce characteristics, including demographics, qualifications, and job information such as employer and professional role. Some extracts include data from school years 2019–2020 and 2020–2021, collected before the PDIS redesign and new employment verification policy; others contain data from the 2021–2022 and 2022–2023 school years, post-redesign and staff verification policy. The 2019–2021 datasets incorporate data from background checks and unemployment insurance wage records to confirm employment status as employment verification was not required in the PDIS data at the time. LINC data scientists used identifiers like name and birthdate to match records across PDIS versions and, in the case of the older PDIS data, to data sources that were used to verify employment status. In addition to extracts from PDIS, LINC data scientists provided the study team with 1) a crosswalk file that mapped records from PDIS before the redesign to equivalent records from the newer data; and 2) an indicator of active status in the pre-redesign PDIS that reflected validated information from other data.

To understand workers' employment trajectories, we followed individuals' employment status over time through the four years of data. Table 1 outlines how employment status was defined.

Table 1. Employment Status Definitions by Dataset

	2019–2021 (strict)	2019–2021 (relaxed)	2021–2023
Active	Measured quarterly • Valid background check AND • Active account in PDIS with job role* AND • Validated with wage data	Measured quarterly • Valid background check OR • Active account in PDIS	Measured annually • Verified as actively employed for this year in PDIS AND • Assigned provider is licensed to operate AND • Not a seasonal worker
Not Active	In PDIS or background check data but does not meet active definition	In PDIS or background check data but does not meet active definition	Verified inactive OR verified as not affiliated with a provider in PDIS
Unverified	n/a	n/a	Director has not yet completed verification
Not in Crosswalk (file mapping records between old and new versions)	In PDIS data after the redesign, but no corresponding record in the older (2019–2021) PDIS		A record in PDIS data before the redesign, but no record in the new (2021–2023) PDIS
Not in Data	Not applicable		A record in the post-redesign PDIS, but only in a seasonal job or at a provider that is not currently licensed

*Some individuals were counted as active under this definition without PDIS accounts if their job role could be imputed from other sources, most commonly the licensing system's unexpired director qualifications.

These definitions varied between the pre- and post-redesign data due to the nature of the PDIS data. The more recent (2021–2023) data verified employment directly in PDIS. This verification was not required in the 2019-2021 data, prompting additional steps to ascertain active employment status. Therefore, we tested two definitions of active employment in the 2019–2021 data. The "strict" definition uses the outside data sources (background checks and unemployment insurance wage records) to verify employment with the goal of identifying the individuals most likely to be

active in the workforce at a given time. The "relaxed" definition casts a wider net across data sources to identify all potential workers.

The analyses discussed in the body of this brief exclude all individuals employed in family child care homes (FCCH) because data collection and verification processes have been much more limited for this population. See Figure 6 in the appendix for a retention analysis limited to an FCCH population.

Findings

Four-Year Retention and History

> **Significant differences in the way active employment status was defined before and after the PDIS system redesign prevent the accurate tracking of worker history and retention over time.**

Figure 1 used an originating cohort (highlighted in the green box) of all actively employed workers in the 2019-2020 school year (n=18,124) with the goal of tracking changes in employment status over four years for these individuals. This analysis used the strict 2019-2021 definition of employment to focus on workers who had the highest certainty of being actively employed at the time. The chart displays movement over time across the five statuses outlined in Table 1.

This analysis demonstrates significant inconsistencies between those who appear in the active workforce pre- and post-PDIS redesign. In addition to a large group of workers moving from active to not active employment status between 2020–2021 and 2021–2022, a significant portion of workers active in the earlier data are classified as unverified, not in the crosswalk, or not in the data in 2021–2022. This means individuals who were working in child care in 2020–2021 were appearing as newly employed in PDIS the next year (unverified by director) or were not showing up in PDIS the following year (not in crosswalk, not in data). Altogether, these changes appear to result in a dramatic drop in retention (a 58% drop in the active workforce between 2019–2020 and 2021–2022). However, the timing of this sudden and drastic reduction in retention is inconsistent with earlier patterns in retention, which declined only 23% from fall of 2019 to fall of 2020, despite COVID shut downs in spring 2020. In consultation with the Colorado Lab and CDEC staff, we concluded that the PDIS transition most likely is the cause of this sudden apparent decrease in retention.

Figure 1. Employment Status Over Four Years for Individuals Employed at the Start of School Year 2019–2020 (N=18,124)

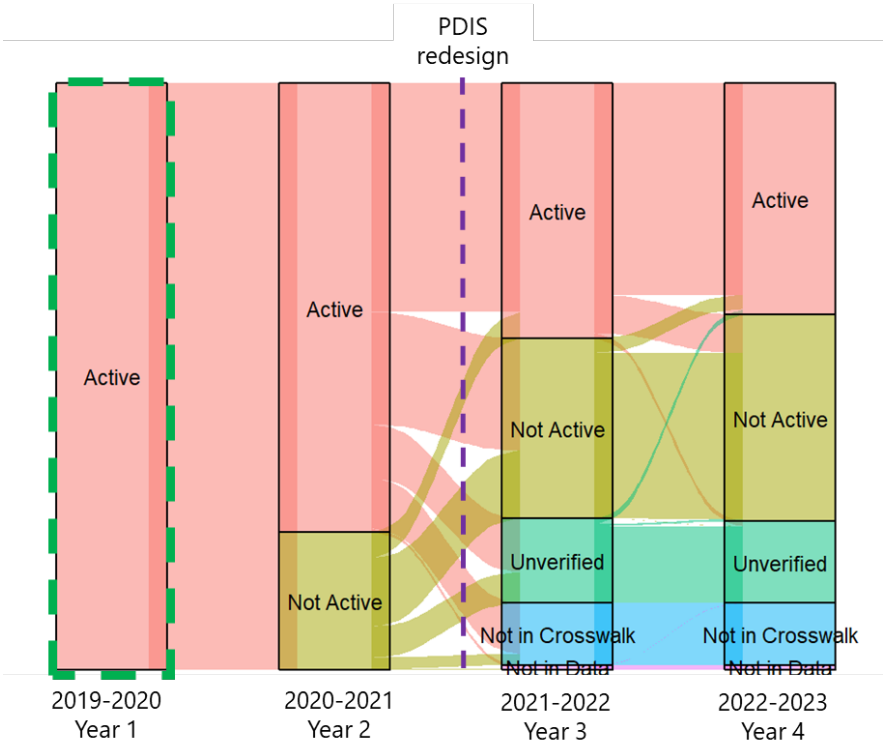
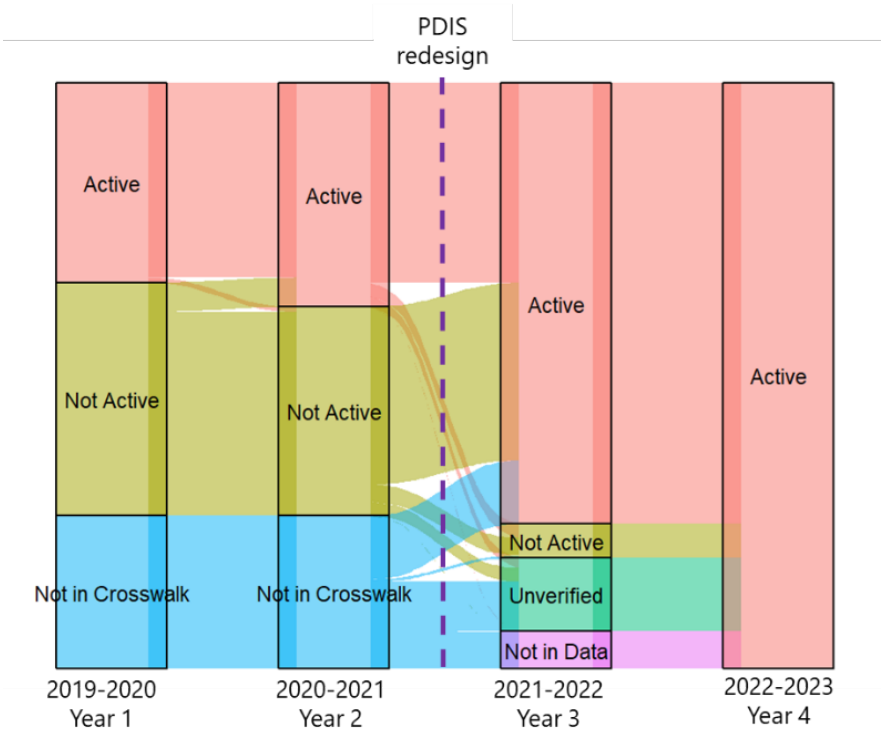


Figure 2 shows a second way of examining longitudinal workforce trends over the four-year period. This figure used an originating cohort (highlighted in the green box) of all actively employed workers in 2022–2023 (n=21,294) and displays the cohort's employment history over the previous four years. This figure uses the relaxed 2019–2021 definition of active employment to maximize the chances of finding 2022–2023 workers in the prior years' data.

Figure 2. Employment Status (Left) Over the Previous Four Years for Individuals Employed During School Year 2022–2023 (N=21,294)



Despite the use of the relaxed definition, we again see an especially large shift at the time of the data transition. Large numbers of individuals who were working in 2022–2023 were also working the previous year (2021–2022). However, in the 2020–2021 school year, many of these individuals were not in the data (i.e., were new to the field after the PDIS re-design) or were not actively working (i.e., they had PDIS accounts but were not assigned to an employer in 2020–2021). While 76% of the 2022–2023 cohort was identified as actively employed by their directors during school year 2021–2022, only 40% of the same cohort appear as actively employed by their directors in winter of the 2020–2021 school year. Again, the suddenness and size of this drop at the time of the data system change suggest that changing data definitions and collection methods prevent accurate measurement of employment trajectories across PDIS system changes.

Two-Year Retention and History

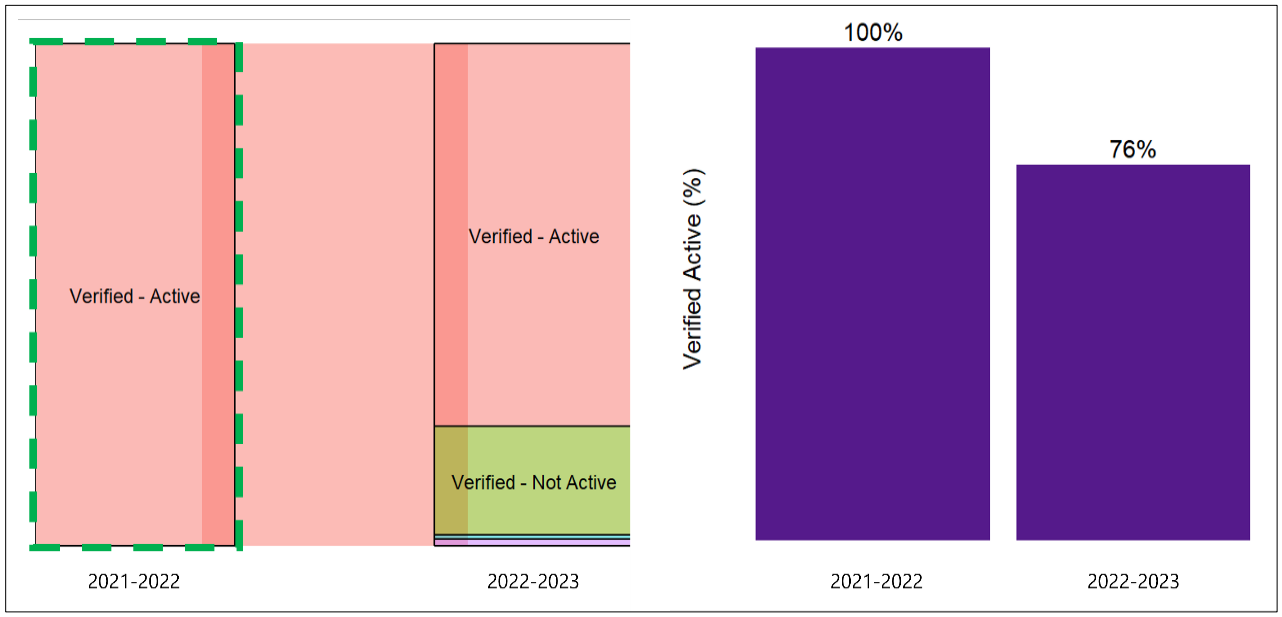
> **Because the data verification process happens at different times during the year for different providers, longitudinal measures of worker employment are difficult.**

Given the discrepancies over the four-year period, we also examined retention and history over only the two most recent years of data (after the PDIS redesign and staff verification policy were in place). Figure 3 shows a cohort of active workers (highlighted in the green box) in the 2021–2022 school year (N=21,208) over a two-year period. By focusing only on the most recent two years of

available data, we used a single, verified definition of active employment status (Table 1). Additionally, we were able to use a richer set of worker characteristics collected only after the PDIS redesign. In the appendix, for example, we provide figures that look at two-year trajectories for full-time/part-time status and by job role (Figures 7 and 8).

The left panel of Figure 3 displays the flow of workers between the 2021–2022 and 2022–2023 school years. Year-over-year retention is shown on the right panel of Figure 3; nearly one quarter of those employed during school year 2021–2022 left the workforce one year later.

Figure 3. Employment Status (Left) and Retention Rate (Right) Over Two Years for Individuals Employed During School Year 2021–2022 (N=21,208)



Similar to the four-year analysis, we examined the employment history over two years of an originating cohort of active workers (highlighted in the green box) in 2022–2023 (N=21,294) in Figure 4. On the right side of Figure 4, a bar chart shows that nearly one quarter of active workers in 2022–2023 were new entries or re-entries. The corresponding alluvial chart shows that this group included re-entries from "Verified-Not Active" (workers who were previously in PDIS but were verified as not active in the 2021–2022 school year) as well as individuals who are entirely new to PDIS ("Not in Data"). The largest prior status, however, is "Unverified." This group likely reflects individuals who began working in the 2021–2022 school year but after their provider had already completed annual verification; these individuals would not be verified as employed until 2022–2023.

The large "Unverified" group in Figure 4 highlights a limitation of annualized employment status verification in PDIS. Because providers may verify employment only once per year (before their annual licensing renewal, which does not happen at the same time for all providers), verified employment status for individuals who enter or leave a job midyear is inconsistently recorded. PDIS

does capture hire dates and end dates, however, and these dates are also supposed to be director verified.

Figure 4. Employment Status (Left) and Employment Rate (Right) Over the Previous Two Years for Individuals Employed During School Year 2022–2023 (N=21,294)

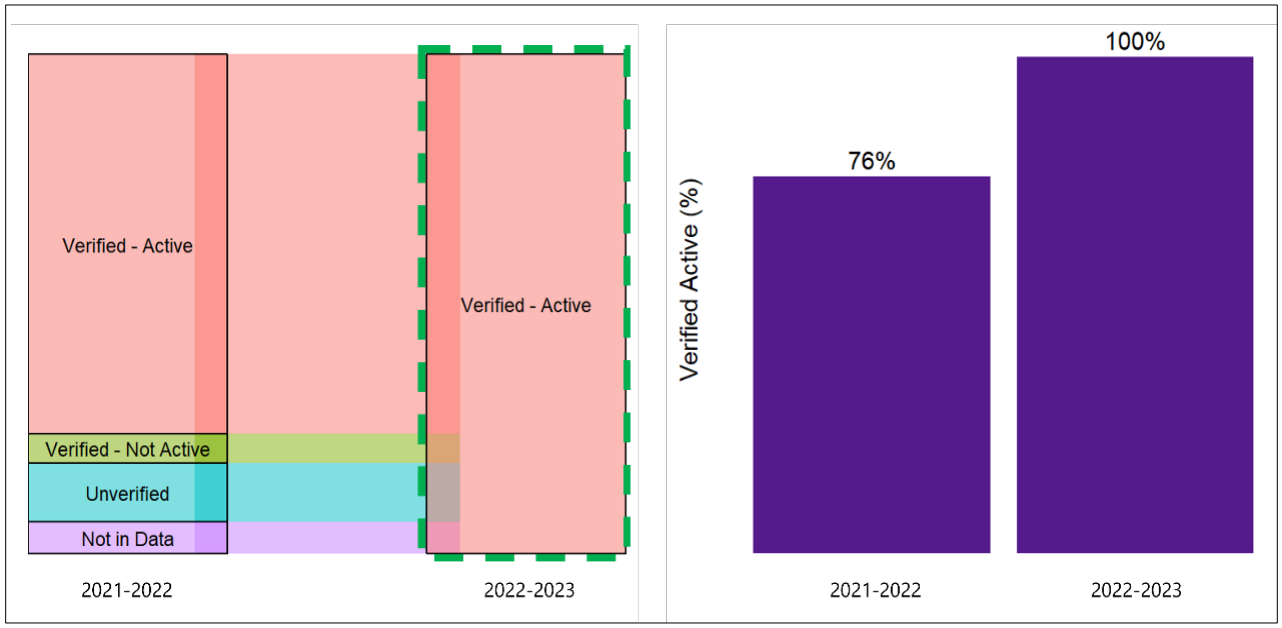
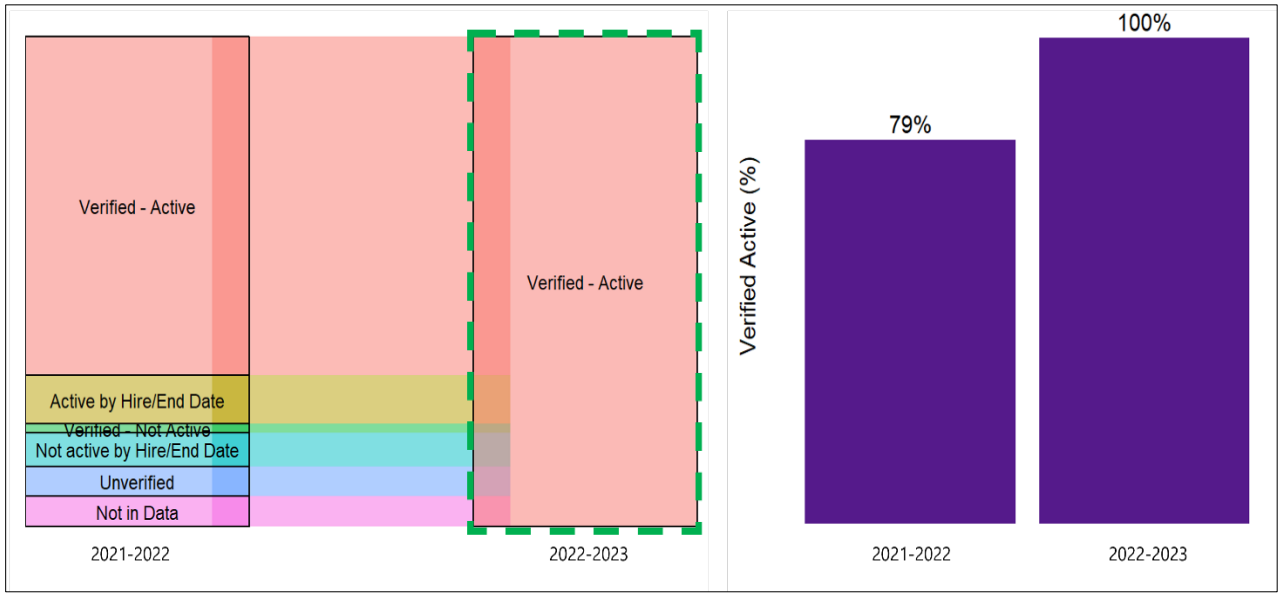


Figure 5 shows the same information as Figure 4 (employment history over the previous two years for individuals employed during the school year 2022–2023). In this version, the employment status in 2021–2022 is refined using hire dates and end dates captured and verified in the school year 2022–2023. Individuals who were classified as "unverified" were reclassified as active in 2021–2022 if they had hire or end dates in 2021–2022 entered when their directors verified their employment status at a later date. This refined definition of active status should more accurately capture anyone who worked in 2021–2022; applying the refined definition particularly reduced the number of individuals from the 2022–2023 cohort who were unverified in school year 2021–2022. It also decreased the number of "new" workers in 2022–2023 by 3% (from 24% to 21%), indicating this metric of recruitment would have been inflated if the hire and end dates were not considered.

Figure 5. Employment Status (Left) and Employment Rate (Right) Over the Previous Two Years for Individuals Employed During School Year 2022–2023 with 2021–2022 Employment Status Refined by Hire Dates and End Dates (N=21,294)



Discussion

Taken together, our four-year analyses suggest significant differences in the active employed populations captured in PDIS before and after the redesign; the individuals who were being recorded as active staff before the redesign are not well aligned with the active staff after the redesign. The movement in retention and employment rates over time strongly supports the idea that this population change does not reflect typical early childhood workforce turnover. Employment status information both before and after the realignment is an imperfect measure, and this noise is compounded when data from the two time points are brought together. Before the redesign, the early childhood workforce was not regularly verified by employers, so some individuals may have been missing from PDIS altogether. Even with the constraints of the strict definition used during the earlier time period, others may have lingered as active even after leaving their employment. The redesign of PDIS cleaned up these inaccuracies, but there remain challenges. The more recent data is most commonly updated annually before licensing inspections which occur at variable times during the year. This means individuals who work for part of a year may appear as verified active, verified inactive, unverified, or may not even appear in the data at all, depending on the date of the data extract and the timing of verification for their employer.

In short, any trends and patterns drawn from the four-year analyses are in part due to changes in data collection and we cannot confidently attribute them to other potential factors (e.g., policy, COVID-19). Due to these challenges, the Chapin Hall team does not recommend further longitudinal analyses with PDIS data that extend back before the 2021 system transition.

Our subsequent two-year analyses show that the data are still imperfect due to the inconsistent timing for employment verification among directors. Entering and exiting employees are inconsistently captured as verified active, verified inactive, or unverified, and some are altogether missing in the year's extract. A preliminary review suggests that hire and end dates are fairly complete after verification and appear accurate, with potential to refine prior data and address this gap. However, the use of hire dates and end dates to effectively determine employment status at a specific point in time is an incomplete solution because some characteristics of interest, such as job roles, have no comparable date fields to indicate duration. Ideally, verification of employment and role would happen together at a consistent, predictable time of year for all workers (twice a year to start), followed by an immediate data extract, preserving a snapshot of a specific point in time for analytic efforts.

Recommendations

We have shared these results with both the Colorado Lab and CDEC. Drawing from those conversations, as well as our experience with these data, we have developed the following recommendations.

> **Define the early childhood workforce based on employer, but conduct some analyses for role-specific subpopulations.**

The (center-based) early childhood workforce should be defined to include all individuals employed at licensed, center-based early childhood providers. Seasonal workers should be excluded; however, this workforce should not be limited by role otherwise. To understand trends specific to certain roles (especially classroom teachers), measures will ideally be calculated both for the full workforce as well as for role-based subpopulations: lead teachers, assistant teachers, and directors.

CDEC is also interested in seeing two-year employment measures for workers in FCCHs and monitoring these measures going forward. Current process and policy changes are being implemented to improve the scope of data collection for this population.

> **Create a common timeline for entering and verifying employment information for staff across all licensed providers.**

In the interest of improving point-in-time knowledge of employment status, CDEC is considering implementing twice-yearly notifications for educators and employers to update their PDIS records in January and June.

The CDEC team would then pull extracts from PDIS in February and July of each year, immediately following these update cycles. These February and July extracts may be used going forward to calculate "raw" retention and recruitment measures. Individuals will be considered active in January if they are: 1) verified active in the February pull with a hire date prior to February 1st, or 2) verified inactive in the February pull with an end date in January. The logic for June would be similar.

In addition, subsequent data pulls can continue to be used to refine previous extracts by retroactively incorporating any updates made to the hire and end dates since the previous extract. The extract 12 months later (for instance, the January 2023 extract for January 2022 data) should, for the most part, capture at least one round of verification among directors and updated hire/end dates for each individual and could be used to calculate "refined" measures of retention: in particular, individuals who were previously "unverified" or not yet added to PDIS can be retroactively indicated as active or inactive based on hire and end dates.[i]

Ideally, as data collection processes improve, the raw and refined measures should draw closer together until raw measures alone are adequate and it is no longer necessary to wait 12 months to finalize retention calculations.

> **Define consistent methodology for workforce metrics so they can be used for ongoing monitoring.**

Based on CDEC's desired metrics from our discussion, we suggest CDEC consider regularly calculating:

- 12-month growth (for the full population, all assistant teachers, all lead teachers, and all directors).
- 12-month retention (for the full population, all assistant teachers, all lead teachers, and all directors).
- 12-month retention of new hires (for the full population, all assistant teachers, all lead teachers, and all directors).

We also recommend the development of at least one longer retention measure – perhaps 24 months. Once several years' worth of data have been collected, it should be possible to see after what period retention rates seem to stabilize.

[i] Hire dates and end dates could conceivably continue to change more than 12 months after the original extract was pulled, meaning that if a raw measure was refined using different, later pulls, the results could look slightly different. Our preliminary analyses suggest that less than 1% of hire dates change year over year, however.

Appendix A

Figure 1. Employment Status (Left) and Retention Rate (Right) Over Two Years for Individuals Employed by Family Child Care Homes During School Year 2021–2022 (N=1,290)

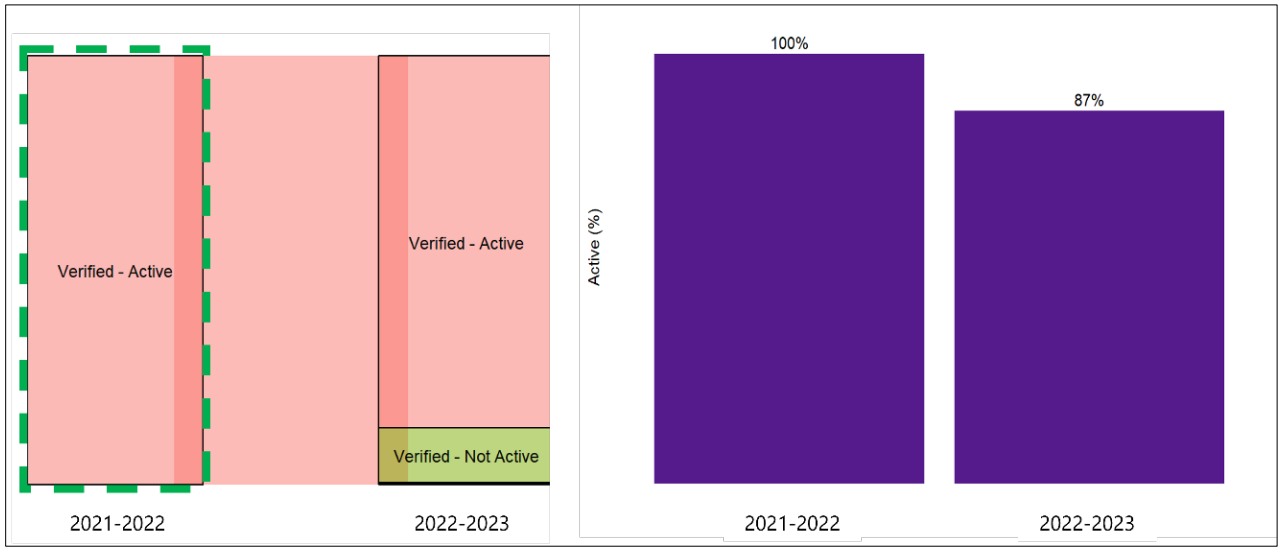


Figure 2. Fully Time/Part-Time Employment Status Over Two Years for Individuals Employed During School Year 2022–2023 (N=21,206)

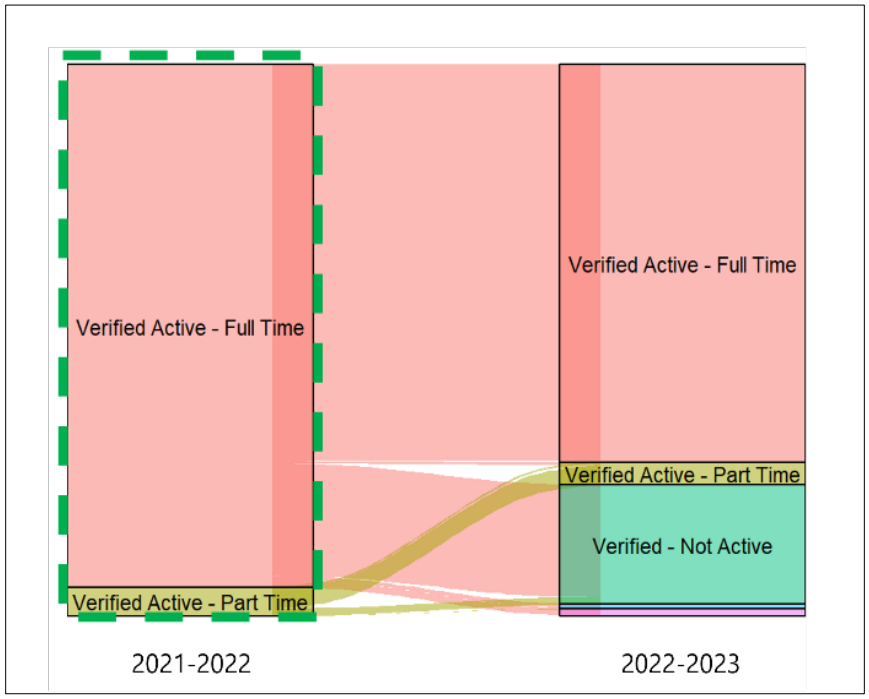
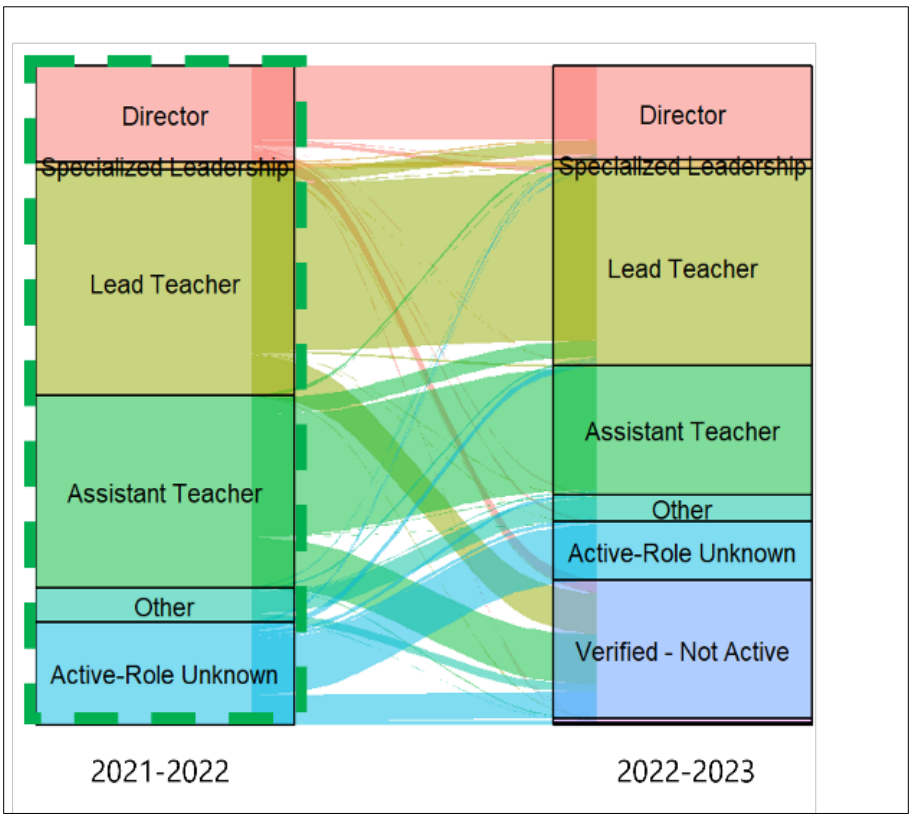


Figure 3. Advancement by Role Over Two Years for Individuals Employed at the Start of School Year 2021–2022 (N=21,208)



Endnotes

[1] Transition Working Group. (2021). *Department of Early Childhood transition report.* https://drive.google.com/file/d/15IG4SdgWjU-xi90fQGs_c_mrWMyK0aQ6/view

[2] Early Childhood Educator Income Tax Credit, C.R.S. § 39-22-547 (2023). https://leg.colorado.gov/sites/default/files/2022a_1010_signed.pdf